DEPARTMENT OF COMMERCE

CIRCULAR

OF THE

BUREAU OF STANDARDS

S. W. STRATTON, DIRECTOR

No. 108

GYPSUM—PROPERTIES, DEFINITIONS AND USES

JANUARY 3, 1921

PRICE, 5 CENTS

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ABSTRACT

This paper contains brief descriptions of the method of manufacture, properties, and uses of the various products made from gypsum.

Gypsum is a rock which consists of calcium sulphate combined with water. It is used in the raw state for the manufacture of Portland cement and as a fertilizer. When heated to such an extent that three-fourths of the water is driven off, the product is known as calcined gypsum or plaster of Paris, which has a great variety of uses. The addition of retarder, hydrated lime, fiber, and sometimes sand, to calcined gypsum makes the gypsum wall plaster of commerce. From the standpoint of tonnage this is the most important gypsum product. When raw gypsum is heated so that all of the water is driven off, the product sets too quickly to be marketable, but is used at the factory to make such products as gypsum tile, gypsum plaster board, gypsum wall board, etc. This is the best material to use for pouring gypsum reinforced structural shapes, cast in place, although calcined gypsum can be used for this purpose.

The Gypsum Industries Association has established a fellowship at this Bureau to assist in developing information about the properties and uses of the various products.

Specifications for calcined gypsum, neat gypsum plaster, gypsum plaster board, and gypsum wall board are included in this paper.

CONTENTS

1. INTRODUCTION

The present generation has seen the rapid development of the gypsum industry to a place of permanence and importance in the building trade. Plaster of Paris and hard wall plaster are gypsum products with which the public is quite familiar, and many new uses for gypsum products, other than as a building material, have been discovered. Gypsum has several valuable properties which are not possessed by any other material. It is therefore adapted to a large variety of uses, not all of which have as yet been commercially developed. In order to take advantage of this opportunity for the expansion of the industry, it is well first to have a knowledge of the different kinds of gypsum products now on the market. Particularly should their names be studied, for the rapid growth of the industry has brought about a confusion of trade terms, which very possibly affects the consumption of the materials. There is a natural reticence about buying or using a material the name of which is not thoroughly established and understood. An explanation of the nomenclature in present use may have the further function of helping to establish definite meanings for the terms.

2. GYPSUM

(*a*) OCCURRENCE AND PROPERTIES

Gypsum is a rock, which usually occurs bedded in the ground in the same way as limestone or any other of our sedimentary rocks. Pure gypsum is pure white in color and has a translucent sheen. It is apt, however, to be colored by small amounts of certain impurities, particularly iron. Its most distinguishing characteristic is its extreme softness, for it can be readily scratched with a pen knife. Not all gypsum is bedded. Sometimes it occurs in pockets or even as bowlders distributed through a magma of clay or limestone. A variety of gypsum, which may be regarded as highly consolidated, so that the crystals have disappeared and the mass has become translucent, is known as alabaster. Gypsite is another variety, which has not been consolidated, but occurs in loose form, frequently mixed with considerable amounts of dirt. Gypsite, gypsum, and alabaster bear a relation to each other which is analogous to the relation between marl, limestone, and marble.

Gypsum is a very common mineral. Large deposits of it occur in many localities throughout the United States. It is mined chiefly in New York, Iowa, Michigan, Ohio, and Texas. Many

other States produce smaller amounts, and there are a number of known deposits which have not yet been commercially developed. A large part of the gypsum used on the Atlantic seaboard is mined in Nova Scotia. Gypsite is mined in Kansas and Oklahoma. Alabaster is not produced in the United States.

Chemically, gypsum is a hydrated sulphate of calcium. The lime and the sulphuric acid are combined in exact equivalents, so that the product is neither acid nor basic, but neutral. The pure material consists, approximately, of 32.6 per cent lime, 46.5 per cent sulphuric anhydride, and 20.9 per cent water. Anhydrite is another material which is of similar, but not identical, composition and which is frequently found associated with gypsum. It is simply calcium sulphate without any water.

(*b*) COMMERCIAL FORMS AND USES

While most gypsum is calcined before it is put on the market, about one-fifth of the total output is sold in the raw state, either crushed or ground. Practically all of this is used for one of two purposes—the manufacture of Portland cement or as a fertilizer.

Freshly made Portland cement sets, or hardens, much too quickly to permit of its being used conveniently. It has been found that a small amount of gypsum will retard this setting. The gypsum, in an amount up to 3 per cent of the cement, is added just before the final grinding, so that it can be thoroughly mixed. Either raw or calcined gypsum will have the same effect, but the total tonnage of raw gypsum which is actually used for this purpose is about five times that of the calcined material. There is a possibility that anhydrite is equally suitable. It is furnished in any size from 3 inches down to dust, to suit the requirements of the purchaser.

Finely ground raw gypsum has attained an established position as a fertilizer under the name of "land plaster." The calcium and the sulphur are both necessary plant foods, and its comparatively high solubility renders it quickly available. The purity of gypsum sold for this purpose is usually prescribed by State law. Commercial products are now to be had so fine that 90 per cent of the material will pass a No. 100 sieve.

3. CALCINED GYPSUM

Most gypsum is calcined before it is put on the market. The process of calcination may be defined as the heating of the gypsum under definite conditions to produce a definite material.

(*a*) MANUFACTURE

The raw gypsum is first crushed, then dried if necessary, and finally ground to a fine powder before it is fed into the calcining kettles. These kettles are aptly described by their name. They are made of iron, and come in various sizes, holding from 2 to 20 tons. Each kettle is provided with a paddle which rotates on a vertical shaft and keeps the mass stirred up. The kettle is set in brickwork and heated by direct fire. A few rotary calciners are now in use. These are quite similar to the rotary kilns used in making Portland cement and lime. If a rotary calciner is used, the gypsum is crushed to about three-fourths inch before calcination, but is not finely ground until afterwards; otherwise there would be too much dust carried up the stack.

It was noted above that pure gypsum contains about 20.9 per cent water. This water is held in chemical combination, so that the material is normally dry, but the water can be driven off by heat. As the steam escapes from the kettle, it tends to carry the powdered gypsum up with it. The whole mass fluffs up and appears to boil. Eventually this violent action ceases, and the mass settles down in the kettle to about its original volume. The material in the kettle at this point is known as "calcined gypsum," sometimes called "first-settle stucco."

(*b*) PROPERTIES

"Calcined gypsum," then, is gypsum from which a part of the water has been removed by heat. Theoretically, this water is given off at 107° C. Practically a slightly higher temperature is used. It takes about an hour to calcine a kettle full of gypsum to "first settle." The chemical reaction involved is: $2(CaSO_4.2H_2O) + \text{heat} = 2CaSO_4.H_2O + 3H_3O$. Calcined gypsum is therefore $2CaSO_4.H_2O$, or, as it is more usually written, $CaSO_4.\frac{1}{2}H_2O$. From this formula it is frequently called the "hemi-hydrate." Calcination reduces the water content from 20.9 per cent to 6.2 per cent and the proportions of the lime and sulphuric anhydride are thereby raised to 38.6 per cent and 55.2 per cent, respectively.

Calcined gypsum has many peculiar and valuable properties. When mixed with water to form a plastic mass, it sets or hardens. This set can be easily regulated to take place in any desired time. The setting is accompanied by expansion, which property is of great value in making casts or molds. The set material is nearly as strong as Portland cement, and yet is soft enough so

that it can be readily tooled. Its porosity and consequent ability to absorb water is important when it is used for making pottery molds. Its ability to set before it dries is the property which makes it valuable as a gaging plaster.

(*c*) COMMERCIAL FORMS AND USES

Calcined gypsum is probably best known to the general public as " plaster of Paris," but it is sold under a great variety of names, depending upon the purpose for which it is to be used. Thus "dental plaster" is used by dentists and physicians for making plaster casts and impressions. "Molding plaster" is used for making the plaster decorations with which ceilings and walls are sometimes embellished. If the material is used in making plaster casts, statuary, etc., it is called "casting plaster." Under the name of "potters' plaster" it is used for making molds in which terra-cotta, porcelain vases, and other clay products are molded. It is used by the plasterer to mix with lime putty for the "white coat" of plaster, in which case it is called "gaging plaster." All of these materials are essentially calcined gypsum, differing from each other chiefly in the extent to which the time of set has been regulated.

It is unfortunate that such a confusion of nomenclature has come into common use. This is particularly true because there is a tendency now to acknowledge that all of the above names are incorrect. The word "stucco" has been defined by architects and builders to mean a material which is applied in a plastic condition to form that surface of a wall which is exposed to the weather, and which will harden or "set" on exposure. This definition is in contradistinction to the word "plaster," which is the same kind of material, but which is used only on interior walls and ceilings. The material which the gypsum man calls stucco could never be used to make stucco in the way in which the architect understands the word. Nor is the material in any sense a plaster except possibly that small amount of it which is used as gaging plaster. The gypsum manufacturers have been broad enough to see this difficulty and to adopt severe means to meet it. They have decided to drop all of the names above, and to call this material simply "calcined gypsum." Such action is worthy of commendation and support. Of course, such radical changes can not be brought about by legislation, so that it is hardly likely that this generation will be able to declare the old terms obsolete.

Many of the minor uses of calcined gypsum have been designated above in the paragraph on nomenclature. Next in commercial importance to its structural uses is its use as a retarder for Portland cement. For this purpose, however, much more gypsum is sold raw than calcined. In the manufacture of plate glass, the glass is bedded in gypsum to hold it while grinding the surface. Calsomine, or cold-water paint, is a mixture of calcined gypsum and specially prepared glue, with or without pigments.

4. HARDENING OF CALCINED GYPSUM

When calcined gypsum sets, it first dissolves in the mixing water. It then combines with the same amount of water that was driven off during the calcination process, and thereby forms a compound which is identical with raw gypsum rock. This raw gypsum, being less soluble than the calcined form, crystallizes out of solution, the crystals interlocking with each other and giving strength to the mass. Since it requires heat to calcine gypsum, it follows that the change back from the calcined to the original form is accompanied by an evolution of heat.

The normal time of set is from 5 to 10 minutes; that is, the mass will become hard in 5 or 10 minutes after the calcined gypsum is mixed with the water. The final setting may be hastened by any means which will aid crystallization. Usually acceleration is accomplished by adding a few crystals of set gypsum to the material. These form nuclei for the crystallization of the rest of the mass, and thereby hasten the reaction. Dental plasters are frequently accelerated so that they will set in one or two minutes. Conversely, any material which tends to prevent crystallization will retard the final setting. It has been found that colloidal substances are very effective for this purpose. The retarder generally used is a by-product of the tanning industry, similar to glue. Some ready-mixed wall plasters are retarded to set in not less than 6 hours.

Evidently, the time of set of calcined gypsum can easily be controlled to suit the purpose for which it is to be used. This is a distinctive property of this material, and a very valuable one. Accelerators and retarders apparently have little effect on the rate of setting; they merely change the time at which the reaction begins. Judging from the evolution of heat, the reaction in all cases seems to be complete in about half an hour from the time it begins. After the crystallization is complete, further time can not be expected to show further change. Maximum strength is

developed immediately upon the completion of the set. Of course, freshly set gypsum contains a great deal of excess water, and, in common with all similar materials, it is weak on this account. Drying may be accomplished quickly, however, so that an object made of gypsum can be brought to its final strength and condition in a few hours after the calcined gypsum is mixed with water. It is particularly to be noted that this setting does not depend upon exposure; the mixing water furnishes the only ingredient necessary for its completion.

The compressive strength of a good sample of set gypsum (when tested in the form of a cylinder 2 inches in diameter by 4 inches high) is about 2000 pounds per square inch. Its tensile strength is about 400 pounds per square inch. The age of the specimen makes no difference, provided only that it has had time to set completely, and that it is dry. The quantity of water used for mixing the calcined gypsum does decidedly affect the strength of the set material. Use as little water as possible and still have the mixture workable.

5. GYPSUM WALL PLASTERS

About three-fourths of all the gypsum mined finds its final market as wall plaster. The simplest form of gypsum sold for this purpose is the straight calcined gypsum, which is used as an addition to lime putty for white-coat work. This is sold as "gaging plaster," sometimes called "stucco," and can be had either unretarded or retarded to set in about 20 minutes.

Calcined gypsum does not work so smoothly under the trowel as could be desired. As a concession to the plasterer, therefore, it has become common practice to add 10 per cent to 15 per cent of clay or hydrated lime to the material at the mill. The mixture so produced, retarded to set in from one to six hours, is the gypsum plaster of commerce, which is sometimes termed "hard wall plaster." It is also sold as "neat gypsum plaster" in the East and as "cement plaster" in the West. The adjectives "fibered" and "unfibered" denote whether or not any hair or wood fiber has been added to it.

Neat gypsum plaster is designed to be used for the scratch and brown coats of plaster. For this purpose sand must be added to it on the job. For scratch-coat work it is customary to use 1 part of neat plaster by weight to 2 parts of sand; for brown coat the proportions are 1 to 3. Plaster to which the sand has

been added at the mill is now obtainable. It is known as "gypsum sanded plaster," "ready-mixed scratch coat," or "ready-mixed brown coat."

Another variety is known as "wood-fiber plaster." This is neat gypsum plaster containing about 1 per cent by weight of wood fiber. It is designed to be used with or without sand, depending upon the nature of the base or background to which it is to be applied.

Wall plasters and other building materials made of gypsum have a remarkable ability to resist fire.[1] The reason for this is due to the chemically combined water of crystallization, which, as stated, is about 20 per cent by weight. The heat breaks up these crystals and liberates the water, the process being slower as the heat penetrates farther into the gypsum. As long as there are any water crystals in the gypsum to be broken up the material will not warm appreciably above the temperature of boiling water.

6. SECOND-SETTLE CALCINED GYPSUM

If, instead of emptying the kettle when the material first subsides in it, the heating is continued, the former phenomena of ebullition and subsidence will be repeated. When the material has settled down the second time no further apparent effect can be obtained by further heating. This material is known as "second-settle calcined gypsum," sometimes called "second-settle stucco."

The reaction involved in this second calcination is expressed by the equation $2\ CaSO_4.H_2O + \text{heat} = 2\ CaSO_4 + H_2O$. That is, second-settle stucco is anhydrous calcium sulphate, all of the water having been driven off by the calcination. This substance is identical in chemical composition with the naturally occurring mineral, anhydrite. But there is a vast difference in their physical and chemical properties. To indicate this distinction, second-settle stucco is frequently called "soluble anhydrite." They both have the same crystal form but different optical properties. Both forms react with water, but at extremely different rates. It is a matter of weeks before natural anhydrite can be made to combine with water to form set gypsum. Soluble anhydrite seizes water with avidity. When mixed to a plastic condition it sets more rapidly than calcined gypsum (the hemi-hydrate). A

[1] Gypsum as a Fireproofing Material, by Virgil G. Marani, Journal of the Cleveland Engineering Society; November, 1914.

few minutes exposure to the air suffices for it to absorb enough water to revert to the hemi-hydrate.

Besides its quicker set, soluble anhydrite has other advantages over calcined gypsum. It requires less water to make it plastic, and consequently makes a harder, denser, stronger set material. Unfortunately, as noted above, it will not keep. Manufacturers tried to put soluble anhydrite on the market, but found that by the time it reached the consumer it had largely reverted to calcined gypsum, so that the extra expense caused by the second calcination was thrown away.

Large quantities of second-settle calcined gypsum are made for immediate use at the mill in the manufacture of precast gypsum tile (plain or reinforced), plaster board, wall board, etc.

7. FURTHER PRODUCTS OF CALCINATION

The change from calcined gypsum to soluble anhydrite occurs at 250 to 300° C. If the heating is prolonged, soluble anhydrite gradually changes its physical structure and becomes natural anhydrite. This is complete just below a red heat.

Natural anhydrite will set if given time enough. It is used in Europe under the name of "flooring gypsum." It sets into a very dense, hard mass, which makes an admirable floor. The American public, however, has not time to wait for it to set, so that it has never been put on the market in this country.

(*a*) KEENE'S CEMENT

Keene's cement is a gypsum product which is used for wall plaster. It sets more slowly than calcined gypsum, but produces a harder, denser surface. The original process for making this material was patented, and therefore a matter of public knowledge, but it is believed that new secret processes have completely replaced the original method. Judging from its composition and behavior, it would seem that Keene's cement is natural anhydrite to which some accelerator such as alum or borax has been added. This material can also be produced by burning select, ground, white gypsum at high temperatures.

Further heating of natural anhydrite to about 1300° C will eventually result in its decomposition. Gaseous sulphur trioxide is evolved, and lime remains. This reaction finds no commercial use at present.

8. STRUCTURAL GYPSUM PRODUCTS

(*a*) PRECAST PRODUCTS

(1) GYPSUM TILE

The quick-setting property of gypsum and its high strength make it an ideal material to cast into tiles at the mill. These tiles are shipped as such, and laid up to form walls, in the same way as brick or stone. Gypsum tiles come in a great variety of sizes, to suit all purposes. One size commonly used for building partitions is 12 inches wide by 30 inches long by 3 inches thick. They are usually "cored"—that is, holes run through them longitudinally—although solid tiles can be obtained. These holes are introduced principally to make the tiles lighter, thereby reducing the freight costs and the labor of handling. The air spaces which they form may assist the tile somewhat to resist the transmission of heat. For the same reasons, the tiles are usually made of calcined gypsum in which is included not more than 5 per cent, by weight, of wood fiber. This makes them of such a nature that they can be cut with a wood saw. Gypsum tiles must be set in gypsum mortar, made of 1 part calcined gypsum, by volume, to 2 parts of sand. One tile of the material and the dimensions noted above will weigh about 30 pounds. When laid on edge, the usual method, it can be expected to carry a load of 1260 pounds with a large factor of safety. The surfaces of these tiles are usually roughened to form a key for the plaster.

In the design of precast reinforced gypsum tile, strength rather than lightness is the paramount consideration. These tiles do not contain any sand or fiber, and are of solid or cored pattern. They are made of second-settle calcined gypsum, with as little water as possible, so as to develop maximum strength. Tiles of this character are used mainly for roof construction, being covered, of course, with standard roof coverings to protect them from the weather. While certain stock sizes are recognized, it is customary to make the tile to order, so that they will fit into the supporting members of the roof.

(2) GYPSUM PLASTER BOARD

Gypsum plaster board is a board made of calcined gypsum which is used as a lath-and-plaster construction. It consists, essentially, of a thin layer of gypsum contained between two layers of paper. Plaster boards are 32 by 36 inches and vary in thickness from one-fourth to one-half of an inch. The gypsum contains wood fiber as an aggregate, which reduces its brittleness,

so that the boards can be nailed directly to the studs. The surfaces of the boards are roughened, and the paper is not sized. This construction forms a good bond for the application of plaster.

(3) GYPSUM WALL BOARD

Gypsum wall board is quite similar in construction to plaster board. Wall board, however, is not intended to be plastered, but the surface of the board forms the finished wall. Therefore the surface of a wall board is smooth, and the paper is sized. Wall board comes in strips 32 or 48 inches wide, varying in length from 4 to 10 feet. Its thickness may be from three-eighths to five-eighths of an inch. It is erected on walls in such a way that all joints are vertical, the length of the board being cut to correspond with the height of the ceiling, thereby avoiding horizontal joints. The boards are nailed directly to the studs or ceiling supports. The joints may be covered with wooden strips, which give the wall a paneled effect. Some types of wall board have the edges so finished as to permit of the joints being filled with a putty of calcined gypsum. Another method is to cover the joints with strips of paper the same color as that forming the surface of the board. Either of these methods produces a joint which is barely visible.

(*b*) STRUCTURAL MEMBERS CAST IN PLACE

Gypsum structural members, either plain or reinforced, can be cast in place in a manner similar to that used for pouring concrete. For this purpose, certain peculiarities of the material must be borne in mind. The one underlying principle is that maximum strength can be attained by getting as much gypsum as possible into a given space. A calcined gypsum to which nothing but retarder has been added should be used. Sand is purely an adulterant, the use of which may or may not be justified by the reduced cost. An excess of water is particularly bad; use as little as possible and still have the material workable. The time of set of calcined gypsum can be regulated at will by adding retarder or accelerator in the mixer or mortar box. Gypsum will set without drying out. Its maximum strength is attained when it is set and dry, and is not dependent upon its age. Intelligent use of these three properties enables the contractor to regulate the time of set so that he can remove the forms at his own convenience, and so that each member will be strong enough to take its full load before the superstructure need be erected on it.

9. PACKAGES AND STORAGE

Crushed raw gypsum is usually shipped in bulk. The ground material for land plaster comes in cotton or burlap bags holding 100 pounds each.

The best grades of pure calcined gypsum are shipped in paper-lined wooden barrels, which hold from 250 to 320 pounds net. Neat gypsum plasters come in burlap bags holding 100 pounds or in paper bags holding 80 pounds each. Ready-mixed (sanded) plasters are shipped in burlap bags of 100 pounds.

Calcined gypsum will absorb water; otherwise it would not set and would be of no value. Therefore, when this material must be stored, it is necessary to protect it from the weather. It should even be protected from dampness if it is to be stored for six months or longer. When reasonably protected from moisture, it will keep indefinitely and may be considered as being good until used. Cases are on record where calcined gypsum stored in tin cans or in paper-lined wooden boxes showed no deterioration in 10 years.

10. WORK OF THE BUREAU OF STANDARDS

The work which this Bureau is conducting on the subject of gypsum may be divided into three general classes: Cooperation, research, and routine.

The Gypsum Industries Association, with offices in Chicago, is a national organization of manufacturers of gypsum and gypsum products. It maintains a fellowship at the Bureau of Standards to assist in conducting that research work which is necessary to advance the interests of the industry.

The Bureau of Standards' Plastering Conference is endeavoring to write specifications covering the use of gypsum plaster.

At the request of the Gypsum Industries Association or of the American Society for Testing Materials, or frequently on its own initiative, the Bureau has undertaken research work on gypsum. Methods for measuring the time of set, normal consistency, fineness, strength, and similar properties of calcined gypsum have been developed and adopted. A method has been invented for making colored plaster from gypsum wood-fibered plaster. The acoustics and the fire resistance of plastered walls and the properties and uses of gypsum tiles are subjects now under investigation.

Routine tests are conducted as a basis of purchase when gypsum products are bought by other branches of the Government service.

The American Society for Testing Materials is developing specifications for gypsum and gypsum products. The Bureau of Standards and the Gypsum Industries Association are largely responsible for the work on this subject which has been accomplished by this society.

Specifications for calcined gypsum, neat gypsum plaster, plaster board, and wall board have been adopted as tentative by the American Society for Testing Materials, and are recommended by the Bureau of Standards as given in sections 11, 12, 13, and 14, which follow.

The data upon which these specifications are based have been developed by the Bureau of Standards with the full cooperation of the Gypsum Industries Association.

11. SPECIFICATION FOR CALCINED GYPSUM

1. DEFINITION.—Calcined gypsum is the product resulting from the partial dehydration of gypsum by means of heat.

2. TESTING.—The chemical and physical properties of calcined gypsum shall be determined in accordance with the Tentative Methods for Tests of Gypsum and Gypsum Products (serial designation, C 26–20 T) of the American Society for Testing Materials.

I. CLASSES AND SIZES

3. CLASSES.—Calcined gypsum is divided into three classes on the basis of its purity, as follows:

Class A.—Containing not less than 88.4 per cent of $CaSO_4.\frac{1}{2}H_2O$. (These figures correspond to 90 per cent purity in the gypsum.)

Class AA.—Containing not less than 71.7 per cent of $CaSO_4.\frac{1}{2}H_2O$, nor more than the similar quantities specified for Class A. (These figures correspond to 75 per cent purity in the gypsum.)

Class AAA.—Containing not less than 60.5 per cent of $CaSO_4.\frac{1}{2}H_2O$, nor more than the similar quantities specified for Class AA. (These figures correspond to 64.5 per cent purity in the gypsum.)

4. SIZES.—Calcined gypsum (all classes) may be sold in one of the following sizes:

No. 1.—Material of this size shall all pass a 14-mesh sieve, and not less than 75 per cent of it shall pass a 100-mesh sieve.

No. 2.—Material of this size shall all pass a 14-mesh sieve, and not less than 40 nor more than 75 per cent of it shall pass a 100-mesh sieve.

II. SAMPLING

5. SAMPLING.—At least 3 per cent of the packages shall be sampled and shall be so selected as to be representative of the contents of the shipment. Samples shall be taken from both the surface and the center of the packages. The material so obtained shall be thoroughly mixed and reduced by quartering to provide not less than a 15 pound (7.5 kg) sample for the laboratory.

6. LABORATORY SAMPLES.—All laboratory samples shall immediately be placed in an air-tight container and shipped to the laboratory for test.

III. CHEMICAL PROPERTIES

7. The chemical composition, within the limits prescribed by section 3, shall be a matter of contract.

IV. PHYSICAL PROPERTIES

8. FINENESS.—Calcined gypsum may be purchased in any of the sizes enumerated for calcined gypsum in section 4. Each package or each shipment, shipped for resale, shall be accompanied by a tag or card which shall contain the information required by section 20.

9. COLOR.—Specification to be supplied by the committee when the information is available.

10. PLASTICITY.—Specification to be supplied by the committee when the information is available

1. TIME OF SETTING.—The time of set of calcined gypsum shall be suitable for the purposes intended, and shall conform to the provisions prescribed for such in the Tentative Specifications for Gypsum Plasters (serial designation, C 28–20 T) of the American Society for Testing Materials.

12. TENSILE STRENGTH.—Calcined gypsum shall have a tensile strength of not less than 200 pounds per square inch (14 kg/cm^2).

13. COMPRESSIVE STRENGTH.—Calcined gypsum shall have a compressive strength of not less than 1000 pounds per square inch (70 kg/cm^2).

VI. PACKING AND MARKING

20. Calcined gypsum may be shipped in either packages or in bulk.

(*a*) When shipped for resale, the following information shall be legibly marked on each package or on a tag of suitable size attached thereto:

Name of manufacturer;
Brand;
Description;
Net weight of package.

(*b*) When shipped in bulk, a card containing required information shall be conspicuously placed in the carrier.

VII. INSPECTION AND REJECTION

21. INSPECTION.—Inspection may be made either at the point of shipment or at the point of delivery. The inspector representing the purchaser shall have free access to the carriers being loaded for shipment to the purchaser. He shall be afforded all reasonable facilities for inspection and sampling, which shall be so conducted as not to interfere unnecessarily with the loading of the carriers.

22. REJECTION.—Any rejection shall be based upon the specific cause of failure to conform to the requirements of these specifications and shall be reported within 10 working days from the receipt of the shipment by the consignee.

23. REHEARING.—Claims for rehearing shall be valid only if made within 20 working days from receipt of notice of specific cause for rejection.

12. SPECIFICATION FOR NEAT GYPSUM PLASTER

6. DEFINITION.—Neat gypsum plaster is a plastering material in which not less than 85 per cent of the cementitious material is calcined gypsum, mixed at the mill with other materials.

7. COMPOSITION.—Neat gypsum plaster shall contain not less than 85 per cent, by weight, of calcined gypsum. The remainder may consist of materials to control the working quality, setting time, and the fibering.

8. TIME OF SETTING.—Neat gypsum plaster shall set in not less than 1½ hours.

9. TENSILE STRENGTH.—Neat gypsum plaster shall have a tensile strength of not less than 150 pounds per square inch (10½ kg/cm^2).

13. SPECIFICATION FOR GYPSUM PLASTER BOARD

39. DEFINITION.—Gypsum plaster boards are used as a sheet lath or base for gypsum plaster on walls, ceilings, and partitions on the interior of buildings.

40. COMPOSITION.—Gypsum plaster board shall consist of sheets or slabs composed of one or more layers of hydrated gypsum plaster, with or without fiber, reinforced on the surface with chip board or felt.

41. THICKNESS.—The thickness of plaster boards shall average not less than the following:

(*a*) Three-eighths inch thick, with permissible local variations of one-sixteenth inch, plus or minus, and the thickness at any point in the board shall not be less than one-fourth inch.

(*b*) Five-sixteenths inch thick, with permissible local variations of one-sixteenth inch plus or minus, and the thickness at any point in the board shall not be less than three-sixteenths inch.

(*c*) One-fourth inch thick, with permissible local variations of one-sixteenth inch, plus or minus, and the thickness at any point in the board shall not be less than three-sixteenths inch.

42. DIMENSIONS.—(*a*) The width shall be 32 inches, with a permissible variation of one-fourth inch less than the dimension specified, and the length shall be 24, 36, or 48 inches, with a permissible variation of one-half inch, plus or minus.

(*b*) Unless otherwise specifically stated in the order, plaster boards of the widths specified and in lengths of 18 and 30 inches may be included in amount not exceeding 5 per cent of any single carload.

43. WEIGHT.—The weight per thousand square feet of plaster board shall conform to the following:

(*a*) For three-eighths inch thick, not less than 1500 nor more than 2000 pounds.

(*b*) For five-sixteenths inch thick, not less than 1250 nor more than 1600 pounds.

(*c*) For one-fourth inch thick, not less than 1200 nor more than 1500 pounds.

44. STRENGTH.—(*a*) Strength-test samples shall be 12 inches wide and approximately 18 inches long, and when tested shall be supported on parallel knife-edge bearings spaced 16 inches and loaded through a similar bearing midway between the supports.

(*b*) When tested as described, samples taken from the plaster boards shall carry not less than the following loads:

Thickness in inches	Ultimate load	
	Load applied across fiber of surfacing	Load applied parallel with fiber of surfacing
	Pounds	Pounds
3/8	40	20
5/16	35	17
1/4	30	14

The minimum acceptable strength shall be not less than 5 pounds below the averages given.

NOTE.—The figures given above for five-sixteenths and one-fourth inch board have not yet been adopted by the A. S. T. M.

(*c*) Samples tested shall fail by rupture of surfacing and core, and not by the breaking of the bond between the surfacing and the core.

45. CORES.—The cores shall consist of the hydrated calcined gypsum plaster, to which may be added not to exceed 15 per cent by weight of sawdust or other vegetable fiber intimately mixed. Cores shall be of sufficient thickness throughout to make the finished plaster boards conform to the specifications as to thickness of the finished product.

46. SURFACING MATERIAL.—The surfacing material shall be composed of plain chip board, felt, or other stock of the same character, which shall be securely bonded to the core and shall completely cover the larger surfaces, with a permissible variation of one-fourth inch at the edges along the shorter dimension.

47. FINISHED PRODUCT.—The surfaces shall be such that they will readily receive and retain gypsum plaster. The edges and ends shall be reasonably straight and solid. The corners shall be square, with a permissible variation of one-fourth inch in the full width of the boards. The boards shall be free from cracks and imperfections that will render such boards unfit for use.

NOTE.—Plaster boards will be considered acceptable that have their corners blurred or broken, provided that the broken portion is not more than 1½ inches in length.

48. PACKING AND MARKING.—Gypsum plaster boards shall be shipped so as to be kept dry and free from injury. Each board shall be plainly labeled with the name of the brand and of the manufacturer.

49. INSPECTION AND REJECTION.—Gypsum plaster boards shall conform to the foregoing requirements and shall be tested as provided for in section 44 when determining their strength. Plaster boards may be rejected upon failure to conform to any of the foregoing requirements.

14. SPECIFICATION FOR GYPSUM WALL BOARD

50. DEFINITION.—Gypsum wall boards are used without plaster coatings as a finish on walls, ceilings, and partitions on the interior of buildings.

51. COMPOSITION.—Gypsum wall board shall consist of sheets or slabs composed of a layer of hydrated gypsum plaster with or without fiber and a surfacing of chip or manila board on both sides.

52. THICKNESS.—The thickness shall average not less than three-eighths inch, with permissible local variations of one-thirty-second of an inch, plus or minus, and the thickness at any point in the board shall not be less than five-sixteenths inch.

53. DIMENSIONS.—Where the wall boards are to be laid with joints butted, the width shall be 32, 36, or 48 inches, with a permissible variation of three-thirty-seconds inch, plus or minus. Where the joints are to be filled with joint filler, the width shall be 31¾, 35¾, or 47¾ inches, with a permissible variation of three-thirty-seconds inch, plus or minus. The length shall be 4, 5, 6, 7, 8, 9, or 10 feet, with a permissible variation of three-eighths inch, plus or minus.

54. WEIGHT.—The weight shall be not less than 1500 nor more than 2000 pounds per 1000 square feet of wall board.

55. STRENGTH.—(*a*) Strength-test samples shall be 12 inches wide and approximately 18 inches long, and when tested shall be supported on parallel knife-edge bearings spaced 16 inches and loaded through a similar bearing midway between the supports.

(*b*) Such samples taken from the wall boards shall carry a load of not less than 80 pounds when the line of supports is at right angles to the direction of the fiber of the surfacing, and not less than 32 pounds when the line of the supports is parallel to the fiber of the surfacing.

(*c*) Samples tested shall fail by rupture of the surfacing and core and not by the breaking of the bond between the surfacing and the core.

56. CORES.—The cores shall consist of hydrated calcined gypsum plaster, to which may be added not to exceed 15 per cent by weight of sawdust or other vegetable fiber intimately mixed. Cores shall be of sufficient thickness throughout to make the finished wall boards conform to the specifications as to thickness of the finished product.

57. SURFACING MATERIAL.—The surfacing material shall be composed of plain chip, manila, filled news, or other stock of the same general character containing sufficient sizing to meet the following conditions:

(*a*) Samples of the finished wall board shall sustain a static head of 1 inch of water (confined within a 2-inch ring on either of the

surfaces of the board) for a period of not less than two hours without penetrating the surface sufficiently to stain the core.

(*b*) The surfacing material shall completely cover the two larger faces of the core and shall be securely bonded to it.

58. FINISHED PRODUCT.—The surface designed to be exposed on erection shall be true and free from imperfections with or without decoration. The edges and ends shall be straight and solid. Where wall boards are to be butted the corners shall be square with both side edges. In cases where the joints are to be filled, the joints shall be square with both side edges with a permissible variation of one-eighth inch in the full width of the boards. The finished product shall be dry and free from cracks and imperfections that would render such boards unfit for use.

59. PACKING AND MARKING.—Gypsum wall boards shall be shipped so as to be kept dry and free from injury. Each board shall be plainly labeled with the name of the brand of the manufacturer.

60. INSPECTION AND REJECTION.—Gypsum wall boards shall conform to the foregoing requirements and shall be tested as provided for in sections 55 and 57 when determining their strength and water permeation. Wall boards may be rejected upon failure to conform to any of the foregoing requirements.

WASHINGTON, September 18, 1920.